

INDOOR AIR QUALITY ASSESSMENT

**Agape Christian Academy
620 Washington Street
Winchester, Massachusetts**



Prepared by:
Massachusetts Department of Public Health
Center for Environmental Health
Emergency Response/Indoor Air Quality Program
June 2006

Background/Introduction

At the request of Jennifer Murphy, Director, Winchester Board of Health, an indoor air quality assessment was done at Agape Christian Academy, 620 Washington Street, Winchester, Massachusetts. The assessment was conducted by the Massachusetts Department of Public Health (MDPH), Center for Environmental Health (CEH) and was prompted by flooding to the first floor of the building in May of 2006, which resulted in water damage to building materials, mold concerns and an evacuation of the building.

On May 19, 2006, a visit was made to this building by Michael Feeney, Director of CEH's Emergency Response/Indoor Air Quality (ER/IAQ) Program, to conduct an IAQ assessment. The ACA is a two-story, brick-clad building originally constructed as a factory. The first floor was subdivided into classrooms with gypsum wallboard (GW) walls and wall-to-wall carpeting. An elevator was retrofitted into the building, with its mechanical systems located in the basement. The basement is located beneath the rear half of the first floor footprint. The basement contains furnaces, electrical equipment and the base of the elevator, which has a pressure equalization vent between the elevator shaft and basement. Windows are openable throughout the building.

The water damage resulted from a rainstorm that delivered an estimated 5.56 inches of rain from May 11, 2006 to May 16, 2006 (Weather Underground, 2006) in the general Winchester area. The rainstorm resulted in significant flooding events throughout Massachusetts. Water from this rainstorm reportedly raised the water table causing a break in a pipe/culvert beneath the building. The subsequently damage caused the basement to flood with several inches of water and moistening carpet in room 105.

Methods

Air tests for temperature and relative humidity were taken with the TSI, Q-Trak, IAQ Monitor, Model 8551. CEH staff also performed a visual inspection of building materials for water damage and/or microbial growth.

Results

The ACA has an employee population of approximately 20 and an estimated 150 students. The tests were taken while the building was unoccupied and appear in Table 1.

Discussion

Temperature readings ranged from 70° F to 75° F, which were within the MDPH comfort guidelines during the assessment. The MDPH recommends that indoor air temperatures be maintained in a range between 70° F to 78° F in order to provide for the comfort of building occupants. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply.

Relative humidity measurements ranged from 40 to 46 percent in the water damaged areas of the first floor of the building, which were within the MDPH recommended comfort range at the time of the assessment. The MDPH recommends that indoor air relative humidity is comfortable in a range of 40 to 60 percent. Relative humidity levels in the building would be expected to drop during the winter months due to heating. The sensation of dryness and irritation is common in a low relative humidity

environment. Low relative humidity is a very common problem during the heating season in the northeast part of the United States.

Upon entering the building a distinct musty odor was noted, which increased in intensity upon approaching room 105 (K5). Room 105 had carpeting which was saturated with water that dampened a paper towel placed on the surface (Picture 1). In addition, GW located around windows was heavily moistened to a point where plastic coving was easily peeled from the wall (Picture 2).

In order for building materials to support mold growth, a source of water exposure is necessary. It is likely that the source of the water moistening building materials was from rainwater accumulated against the corner of the building (Picture 3). It appeared that a section of the roof directs rainwater into this corner. Evidence of heavy water accumulation was observed in this area, including tarmac erosion (Picture 4), moss growth on brick mortar (Picture 5) and breaks in sealant used to join the two building wings (Picture 6). Any seam or crack in the exterior could provide a pathway for driving rain to penetrate the building interior and produce the damage noted in room 105.

The US Environmental Protection Agency (EPA) and the American Conference of Governmental Industrial Hygienists (ACGIH) recommends that porous materials be dried with fans and heating within 24 to 48 hours of becoming wet (US EPA, 2001; ACGIH, 1989). If porous materials are not dried within this time frame, mold growth may occur. Once mold growth has occurred, disinfection of these materials may be possible. Since GW and carpeting are porous surfaces; disinfection is likely to be ineffective. Removal of these materials is likely needed to prevent exposure to mold and other associated pollutants.

“Oil-like” odors were also reported by local health officials prior to the CEH assessment. The elevator mechanical room is located in the basement, which was under several inches of water from a pipe/culvert break. The furnace and other equipment was also under water (Pictures 7 through 9). It is possible that water may have dislodged spilled oil from machinery surfaces or hydraulic fluid from the elevator motor, which initially resulted in “oil-like” odors reported in the front of the building. No oil odors were detected by CEH staff during the assessment.

Due to these odor concerns, CEH staff conducted volatile organic compound (VOC) sampling to ascertain whether these materials were present in the ACA. VOCs are substances that have the ability to evaporate at room temperature. Frequently, exposure to low levels of total VOCs (TVOCs) may produce eye, nose, throat and/or respiratory irritation in some sensitive individuals. For example, oil and hydraulic fluid for elevator motors in the basement would most likely contain VOCs. Indoor TVOC measurements throughout the building were non-detect (ND) (Table 1). Outdoor air samples of TVOCs were taken for comparison. Outdoor TVOC concentrations were ND.

Conclusions/Recommendations

While the remediation efforts to remove water from the first floor appeared to have prevented widespread damage, porous materials that came in contact with the flood water (e.g., GW, carpeting and wall insulation) should be removed. In view of the findings at the time of the assessment, the following recommendations are made (the majority of which were communicated to building management at the time of assessment):

1. Deactivate all electric equipment in the basement.
2. Seal the elevator shaft with polyethylene plastic and duct tape to prevent basement odor migration to the first floor.
3. During removal of building materials use local exhaust ventilation and isolation techniques to control remediation pollutants. Precautions should be taken to avoid the re-entrainment of these materials into the building's HVAC system. The design of each system must be assessed to determine how it may be impacted by renovation activities. Specific HVAC protection requirements pertain to the return, central filtration and supply components of the ventilation system. This may entail shutting down systems (when possible) during periods of heavy construction and demolition, ensuring systems are isolated from contaminated environments, sealing ventilation openings with plastic and utilizing filters with a higher dust spot efficiency where needed (SMACNA, 1995).
4. Remove water damaged materials (e.g., carpeting, gypsum wallboard and wall insulation) in a manner consistent with recommendations found in “Mold Remediation in Schools and Commercial Buildings” published by the US Environmental Protection Agency (US EPA, 2001). Consider replacing carpeting with a non-slip, nonporous material (e.g., rubber matting, tile).
5. Once carpet is removed, use ventilation and dehumidifiers to draw moisture from the cement floor that exists above the slab vapor barrier.
6. If possible, relocate susceptible persons and those with pre-existing medical conditions (e.g., hypersensitivity, asthma) away from the general areas of remediation until completion.

7. Establish communications between all parties involved with remediation efforts (including building occupants) to prevent potential IAQ problems. Develop a forum for occupants to express concerns about remediation efforts as well as a program to resolve IAQ issues.
8. Develop a notification system for building occupants to report remediation related odors and/or dusts problems to the building administrator. Have these concerns relayed to the contractor in a manner that allows for a timely remediation of the problem.
9. When possible, schedule projects which produce large amounts of dusts, odors and emissions during unoccupied periods or periods of low occupancy.
10. Disseminate scheduling itinerary to all affected parties. This can be done in the form of meetings, newsletters or weekly bulletins.
11. Obtain Material Safety Data Sheets (MSDS) for all remediation/decontamination materials used during renovations and keep them in an area that is accessible to all individuals during periods of building operations as required by the Massachusetts Right-To-Know Act (MGL, 1983).
12. Consult MSDS' for any material applied to the effected area during remediation including any sealant, carpet adhesive, tile mastic, flooring and/or roofing materials. Provide proper ventilation and allow sufficient curing time as per the manufacturer's instructions concerning these materials.
13. Implement prudent housekeeping and work site practices to minimize exposure to spores. This may include constructing barriers, sealing off areas, and temporarily relocating furniture and supplies. To control for dusts, a high efficiency

particulate air filter (HEPA) equipped vacuum cleaner is recommended. Non porous materials (e.g., linoleum, cement) should be disinfected with an appropriate antimicrobial agent is recommended. Non-porous surfaces should also be cleaned with soap and water after disinfection.

14. Repair the source of water flooding the basement, which may include the following actions:

- Install a gutter/downspout beneath the roof edge to direct water away from the building edge. Such a system should be of sufficient drainage capacity to handle large downpours.
- Remove moss and repair mortar of brickwork outside room K5
- Repair the joint between the building wings.
- Repair tarmac outside room K5 and regrade surface to direct water from the exterior walls of the building.

References

ACGIH. 1989. Guidelines for the Assessment of Bioaerosols in the Indoor Environment. American Conference of Governmental Industrial Hygienists, Cincinnati, OH.

IICRC. 1999. IICRC S500. Standard and Reference Guide for Professional Water Damage Restoration, 2nd Edition. Institute of Inspection Cleaning and Restoration, Vancouver, WA.

MGL. 1983. Hazardous Substances Disclosure by Employers. Massachusetts General Laws. M.G.L. c. 111F.

OSHA. 1997. Limits for Air Contaminants. Occupational Safety and Health Administration. Code of Federal Regulations. 29 C.F.R 1910.1000 Table Z-1-A.

SMACNA. 1995. IAQ Guidelines for Occupied Buildings Under Construction. 1st ed. Sheet Metal and Air Conditioning Contractors' National Association, Inc., Chantilly, VA.

US EPA. 2001. Mold Remediation in Schools and Commercial Buildings. US Environmental Protection Agency, Office of Air and Radiation, Indoor Environments Division, Washington, D.C. EPA 402-K-01-001. March 2001.
http://www.epa.gov/iaq/molds/mold_remediation.html

The Weather Underground. 2006. Weather History for Bedford, Massachusetts, May 11, 2006 to May 16, 2006.
<http://www.wunderground.com/history/airport/KBED/>

Picture 1



Wet Carpet, Room K5, Note Wet Paper Towel Placed on Floor by CEH Staff

Picture 2



Plastic Coving Easily Peeled From Wall, Lines Denote Area of Obvious Wet GW

Picture 3



Exterior Wall outside Room K5

Picture 4



Tarmac Erosion from Water Impact from Roof

Picture 5



Moss on Brick Mortar outside Room K5

Picture 6



Missing/Damaged Sealant between Building Wings

Picture 7



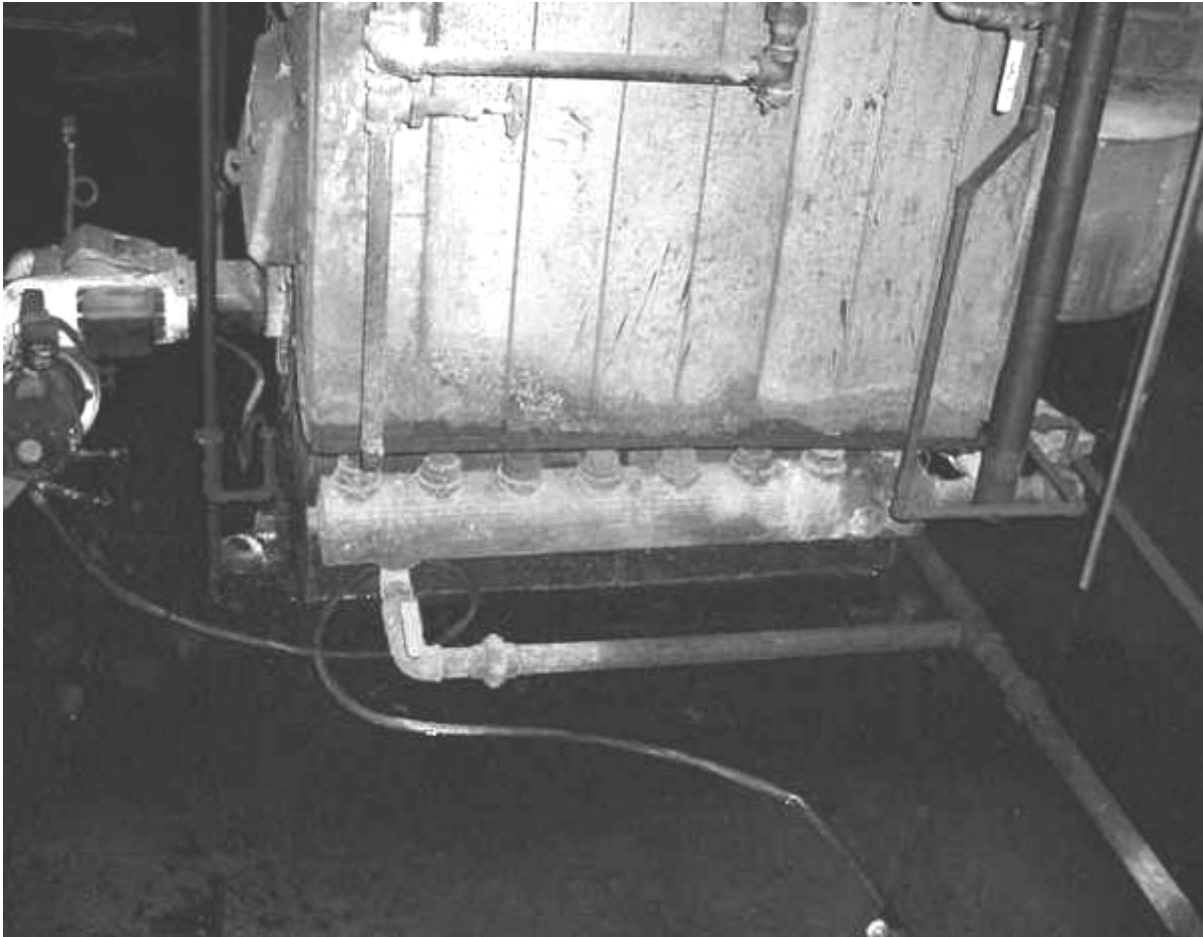
ACA Flooded Basement

Picture 8



ACA Flooded Basement

Picture 9



Furnace, ACA Basement

TABLE 1
Indoor Air Test Results
Agape Christian Academy, 620 Washington Street, Winchester, MA
May 19, 2006

Location	Temp. (°F)	Relative Humidity (%)	Volatile Organic Compounds (VOCs) (ppm)	Windows Openable	Ventilation		Remarks
					Supply	Exhaust	
Outside (Background)	75	41	ND	Y	Y	Y	
104 (K4)	75	41	ND	Y	Y	Y	
105 (K5)	74	44	ND	Y	Y	Y	
Main Office	74	40	ND	Y	Y	Y	
127	73	41	ND	Y	Y	Y	
114	72	41	ND	Y	Y	Y	
113	72	41	ND	Y	Y	Y	
106	71	43	ND	Y	Y	Y	
118	71	45	ND	Y	Y	Y	

* ppm = parts per million parts of air

Comfort Guidelines

Carbon Dioxide - < 600 ppm = preferred
600 - 800 ppm = acceptable
> 800 ppm = indicative of ventilation problems
Temperature - 70 - 78 °F
Relative Humidity - 40 - 60%

Table 1-15

TABLE 1
Indoor Air Test Results
Agape Christian Academy, 620 Washington Street, Winchester, MA
May 19, 2006

Location	Temp. (°F)	Relative Humidity (%)	Volatile Organic Compounds (VOCs) (ppm)	Windows Openable	Ventilation		Remarks
					Supply	Exhaust	
111	71	44	ND	Y	Y	Y	
109	70	45	ND	Y	Y	Y	
117	70	46	ND	Y	Y	Y	

* ppm = parts per million parts of air

Comfort Guidelines

Carbon Dioxide - < 600 ppm = preferred
600 - 800 ppm = acceptable
> 800 ppm = indicative of ventilation problems
Temperature - 70 - 78 °F
Relative Humidity - 40 - 60%

Table 1-16